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BY

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A GAS EXPLOSION IN A ROCK-DUSTED MINE [1]

By G. S. McCaa[2]

Introduction

Rock-dusting is an effective means of preventing coal-dust from propagating an explosion in a coal mine, but it will not prevent gas from igniting explosively and with much attendant damage locally. Ventilation must therefore be effective at all times, regardless of the employment of other explosion-prevention methods, if gas explosions are to be avoided. This paper describes a gas explosion which occurred in a bituminous mine that was well rock-dusted at the point of ignition and which exemplifies the value of rock-dusting, the necessity of maintaining effective ventilation, and the need of permissible rock-dusting machines receiving power from a permissible locomotive.

Description of Explosion

The mine in which this explosion occurred is developed on a panel system in a practically level seam; the panel entries are driven in pairs, and the air current intakes on the right entry and returns on the left entry. Near the mouth of the intake a door is placed to control the ventilation; board stoppings are placed in crosscuts, except the second from the face, in which a brattice cloth curtain is hung, the last crosscut is left open and line brattices conduct the air current from the last crosscut to the faces. In No. 7 entry the last crosscut was 152 feet from the face, the line brattice being within 38 feet of this face, and the second crosscut was 250 feet outby the face of the back entry or return. Seven days prior to the explosion the intake and return entries were rock-dusted to within 38 feet of the face, and as the entry had advanced during the week, the rock-dusting was to be extended.

A rock-dusting machine was being pushed by a cable-reel locomotive with a car of rock-dust between the locomotive and the dusting machine. The rock-dust train was pushed through the controlling door near the mouth of the intake entry, and the motorman closed the door after passing through. The operator of the rock-dusting machine preceded the motorman and went to the face of the return entry to

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test for gas, leaving the curtain in the next to the last crosscut open, as was customary. The locomotive followed, the motorman attaching the head hook of the cable to the trolley wire in the intake entry before entering the return entry, and leaving the curtain open. The motorman, observing the rock-dusting machine operator holding his flame safety lamp about waist high and motioning him to advance, continued to the top of a hill about 50 feet from the face; he then closed the controller, set the brake, and was about to notify the other man to start the rock-dusting machine when a bright flash occurred near the cable reel on the locomotive. He immediately attempted to open the reel switch in the cab end of the locomotive when there was an explosion. The controller was found open immediately after the accident. The motorman was knocked out of the locomotive by the force of the blast, was severely burned about the face, chest and hands, and lost his electric cap lamp. He traveled in the dark a distance of 5,800 feet before he met help and was taken to the surface for treatment.

The rock-dusting machine operator's flame safety lamp was found about 20 feet from the face, and he was picked up by rescuers about 65 feet from the face indicating that he traveled about 45 or 50 feet after the explosion. His heart was still beating when the rescuers arrived and carried him about 325 feet to fresh air. Artificial respiration was applied for 15 or 20 minutes but failed to revive the injured man, who died shortly after reaching fresh air. The rock-dusting machine operator's face, hands, mouth, and tongue were badly burned and the left leg of his trousers, from knee to thigh, was burned off. The two rescuers tested for gas at the point where the injured man was found, but no gas was detected.

The force of the explosion destroyed all of the board stoppings and doors for a distance of 700 feet, and those in line with the force were destroyed for a distance of about 1,000 feet. Stoppings as far as 1,500 feet were caused to bulge. The flame, in so far as could be ascertained, was limited to a zone about 90 feet long in the return entry; the limitation of the flame was no doubt due to the fact that this section of the mine was well rock-dusted from a point 10 to 15 feet outby the assigned origin of the explosion, thereby preventing coal-dust from propagating the explosion, or at least very definitely lessening the violence of any dust propagation which may have occurred.

Factors Contributing to Explosion

Several factors contributed to cause the explosion. Evidently the man in advance of the rock-dusting train made the error, not uncommon with experienced and unexperienced men alike, of failing to test at the roof in the high point about 50 feet from the face; he did test at the face and motioned the motorman to advance, assuming the entry clear of gas. Failure to close the curtain in the second crosscut after the rock-dusting equipment passed through to the return entry may have been a contributing factor also, and it would appear probable that this curtain was open or partly open before the rock-dusting machine came into this part of the mine. With ventilation stopped, gas issuing from the strata at the face would tend to seek the highest point, which in this case was bout 50 feet from the face. A considerable body of the methane might accumulate in 10 or 15

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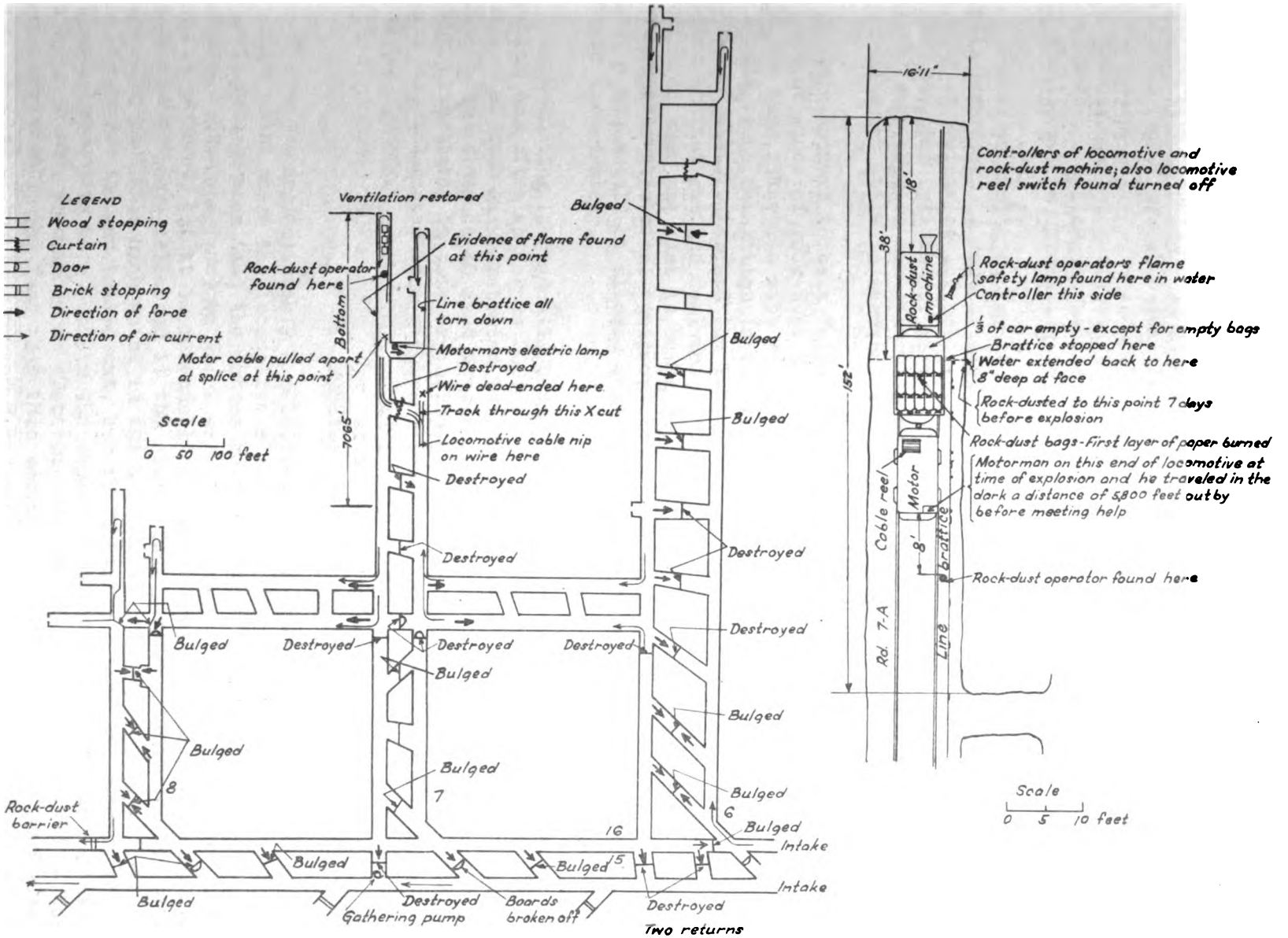

Effect of a gas explosion in in a rock-dusted mine

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minutes if the ventilating current was stopped, although it is probable that the curtain had been open for a longer period. Finally, a source of flame was introduced in the open-type cable-reel locomotive which was used in connection with the rock-dusting unit. The locomotive presented many potential points for producing arcs or sparks; however, it is believed from an inspection of the locomotive cable that a splice in the cable became short-circuited near the reel at the top of the locomotive, and being relatively near the roof, ignited the body of gas.

Cables on mining equipment, especially on cable-reel locomotives, are decidedly hazardous. A manufacturer's agent states that some mines in his district make an average of 1.7 splices per week per cable, and one company buys about 500 patented splices per month. Many splices are made in the mine during the shift; such repairs are generally hurriedly made, with the result that the cables pull apart while in service.

There appears to be a false sense of security on the part of rock-dusting crews; the presence of rock-dust allays their fears of gas and coal-dust ignitions, and the men take liberties with ventilation and open-type electrical equipment. There should be no relaxation in the vigilance necessary to keep a coal mine safe; the rock-dust distributor and the locomotive transporting it have practically no protection against gas and coal-dust at or before the time the rock-dusting is started; even when the dust is being applied, there is no protection against gas. Only permissible electrical equipment, including locomotives, rock-dusting machines, etc., should be allowed near the face of workings and on return airways, even while rock-dusting.

Rock-dusting is gradually becoming standardized. The mines in which the application was often as far as 200 or 300 feet from the face, have recognized the dangers of such an unprotected length of entry and are now making the maximum non-rock-dusted distance 40 feet from the face. The value of such a standard is admirably illustrated in this explosion, and it is earnestly hoped that all mines will soon be rock-dusted from within at least 40 feet of the face of all workings to the mine opening.

Conclusions

There was unquestionably a relatively large accumulation of explosive gas at the high point where the locomotive stood on No. 7 air course. There is no direct evidence to show that the canvas curtain across the haulage chute (second open crosscut from the face) to No. 7 air course was left open before the rock-dust outfit entered, but it is reasonable to assume that this was the case, since the gas would not have collected if the air current had been sweeping the face and traveling past this high point in the air course. There is no means of determining where the gas tailed out, but it is believed that the rock-dusting machine and locomotive were both in the explosive mixture which was undoubtedly ignited by a flame, presumably an electric arc, the exact location of which has not been determined. The fact that this section of the mine was well rock-dusted to within 38 feet of the face on No. 7 air course limited the extent of the explosion essentially to the range of the explosive gas, and coal-dust played little

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or no part in the propagation of the explosion. It is entirely probable that the amount of gas which exploded would have propagated a coal-dust explosion throughout the mine if the mine had not been well rock-dusted.

The essential factors involved in this explosion are as follows:

1. An accumulation of methane existed near the face of No. 7 air course.

2. The locomotive was not of a permissible type and could ignite gas from more than one source by sparking or arcing.

3. Defects were found on the trailing cable that would cause a "short."

4. The rock-dusting equipment did not remain on the intake side outby the haulage crosscut to No. 7 air course until the air course had been tested for gas.

5. There was evident failure of the rock-dust operator to properly examine No. 7 air course.

6. A lighted flame safety lamp was carried by the rock-dust operator, but apparently was not used effectively.

Recommendations

1. Rigid examination of any place into which electric equipment is to enter should be made with an approved flame safety lamp by a competent person; the electrical equipment should remain on the intake side outby the last permanent open crosscut to the parallel entry until the test is completed.

2. Only men who in the opinion of the mine foreman are qualified to hand a flame safety lamp should be entrusted with the examination of working places prior to the entrance of electric equipment.

3. Test should be made at least every half hour while machines are operating in places that may generate explosive gas.

4. The operators of all electric equipment should inspect such equipment at the beginning and the end of each shift for defective cables, loose connections, loose or missing bolts, or for any defect that might cause an accident; effective repairs should be made promptly when defects are found.

5. The rock-dust accumulations on the motor of the rock-dusting machine should be blown off every day.

6. Insulators should be provided for all cables where they pass through steel housings.

7. Cover plates should be kept on commutators.

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8. The bottom chain guard should be kept on the rock-dust machine.

9. No temporary or makeshift electric connections should be permitted.

10. Fire extinguishers of suitable type should be a part of the equipment on all electrically operated compressors and locomotives - such fire extinguishers, for instance, as carried on mining machines in many progressive mines at present.

11. No open-type electric switches should be used.

12. Accumulations of oil and grease around motors should not be permitted.

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